FAA AVIATION NEWS

DECEMBER 1969

COVER

Plane and pilot wear skis for a snowy holiday on New Zealand's Mt. Cook. Happy holiday landings!

FAA AVIATION NEWS

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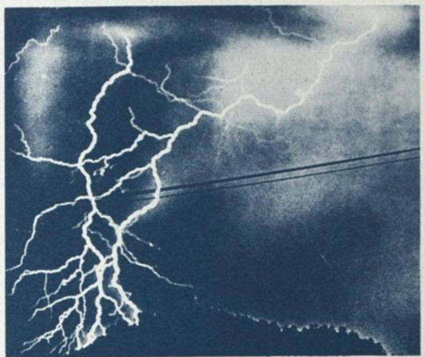

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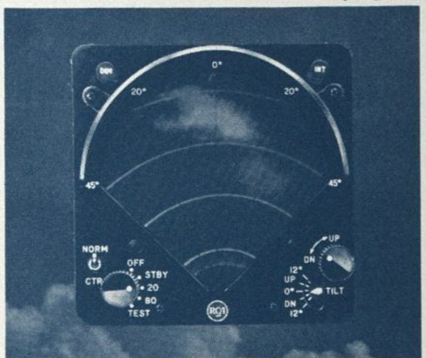

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Rules on Aircraft Engine Noise Forecast a

NEW SOUND For AIRPORTS

THE Federal Aviation Administration has adopted new regulations which establish noise standards and maximum noise levels for all new turbojets as well as new transport type designs, including some airplanes already under development.

The new rules are intended as an important first step in reversing the escalation of aircraft noise around airports. The noise levels prescribed in the new regulations are substantially lower than those associated with jet aircraft currently in service.

Public Law 90-411 gives the agency broad authority in the noise control area, including the authority to withhold certification of aircraft which fail to meet prescribed noise standards. The new regulations, like the statute under which they are issued, do not change the existing division of responsibility and powers between Federal and state and local authorities with respect to alleviation of local aircraft noise problems, nor do they provide a Federal substitute for noise solutions adopted by airport operators as proprietors of their airports.

The new regulation provides airplane noise limits on a sliding scale related to the airplane's gross weight as determined from three measuring points—approach, sideline and takeoff. The noise limits on *approach* are 102 EPNdB (effective perceived noise decibels) for aircraft weighing no more than 75,000 pounds and range up to 108 EPNdB for aircraft in the 600,000 pound-and-over weight class. The measurement of approach noise would be made at a point *one nautical mile from the threshold on the extended runway centerline.*

Sideline noise limits also would range from 102 to 108 EPNdB, with the noise measurement taken at the point on a line *parallel with and 0.35 nautical miles from the extended runway centerline* where the noise level after lift-off is greatest. For aircraft with three or fewer engines, the distance is 0.25 nautical miles from the extended runway centerline.

On *takeoff,* the noise limits would be in the 93 to 108 EPNdB range and would be measured at a point 3.5 nautical miles from the start of the takeoff roll on the extended runway centerline.

The noise limits prescribed in the new rule are in some cases more than 10 EPNdB less than readings obtained for the noisiest aircraft presently in service. (On the logarithmic scale, a reduction of 10 EPNdB represents a halving of perceived noisiness.)

New Rule Includes "Trade-offs"

Provision is made in the rule for "trade-offs" in the maximum noise levels to reflect the fact that total noise exposure is cumulative and that limited exceedances at certain measuring points are therefore acceptable if compensated by noise reductions at other measuring points. For example, an excess of two EPNdB would be allowed on takeoff if compensated for by a similar reduction in the approach and/or sideline noise levels. For aircraft applying for type certifications before December 1, 1969, trade-offs would permit a maximum excess of three EPNdB at any one of the three measuring points.

The new regulations became effective on December 1, 1969, for all new subsonic transport category airplanes regardless of the means of propulsion and to all subsonic turbojet airplanes regardless of category. Aircraft for which application for a type certificate was made prior to January 1, 1967, and which have high bypass ratio engines *(such as the L-500 and Boeing 747)* would be granted additional time to comply with the prescribed noise limits if necessary.

During type certification of these aircraft, the manufacturers will be required to show that "the noise levels of the airplane are reduced to the lowest levels that are economically reasonable, technologically practicable, and appropriate to the particular type design." In addition, they must submit for FAA approval a schedule for acoustic improvement which would bring the noise levels of the aircraft within those prescribed by the new regulation.

FAA is considering separate rule making for vertical takeoff and landing (VTOL) aircraft, short takeoff and landing (STOL) aircraft and the supersonic transports (SSTs). The agency believes that the acoustic technology associated with these classes of aircraft require further study before the agency can comply with the statutory requirements to establish noise certification standards for these aircraft.

FAA is also currently studying retrofit standards for aircraft currently in service. Pending the development of such retrofit standards, FAA would require manufacturers wishing to bring out new versions of existing aircraft (such as a stretched version) to comply with the standards in the new regulations if the modifications would increase the noise exposure created by the airplane. This provision will insure that no further increase of noise can occur in the current U.S. jet aircraft fleet pending the issuance of retrofit standards.

The new regulation—Part 36 of the Federal Aviation Regulations—is based on a Notice of Proposed Rule Making (Notice 69-1, Docket 9337) issued January 6, 1969. ■

VOLTS From the BLUE

The hole in the fiberglas-fabric covered rudder of the C-118 was the size of a volley ball. The pilot, who was unaware of the damage until he stepped down from the aircraft at the completion of what had appeared to be a routine flight, could hardly believe his eyes. There had been no blinding flash, booming jolt, tingling limbs, spinning compasses or other time-honored indications of a lightning strike. Nevertheless, there was the hole in the rudder, and the only explanation for it was "a volt from the blue."

The flight had been conducted at 16,000 feet, in an area of few-to-scattered thunderstorms. Airborne radar had been used to pick a path between precipitation returns. The weather had worsened en route, the thunderstorms had increased in number and size, and the pilot had carefully cross-checked his radar returns with air traffic control radar as the C-118 entered a stratus layer between drifting cloud buildups.

While driving between two sizeable bright spots on the airborne radar, winking about ten miles apart, the aircraft had encountered a flurry of light snow flakes, light turbulence, and precipitation static on VHF. The snow changed to light ice crystals and lightning had flashed several times, seemingly well clear of the aircraft, as the flight continued without incident. Sheer luck determined that the lightning bolt which passed through the rudder did not damage the operating mechanism.

Since not even the best of radar will not paint an area of potential lightning strikes, how is a pilot to know when he is likely to become a target? Perhaps the best forewarning he can have is an intelligent understanding of the general theory of lightning discharges from clouds.

Rapid Transport of Electrons

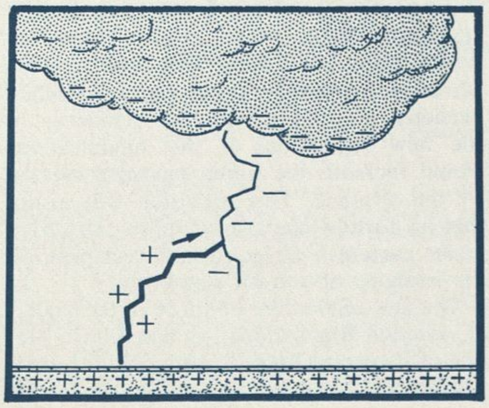
Most lightning theories cluster around the idea that cloud-to-ground strikes are a rapid transport of surplus electrons from thunderstorm charge centers back to earth, thus maintaining the normal negative charge of the clouds. The number of thunderstorms in action all over the earth at any given time varies greatly: anywhere from 300 during a day to 1,800 at a single moment.

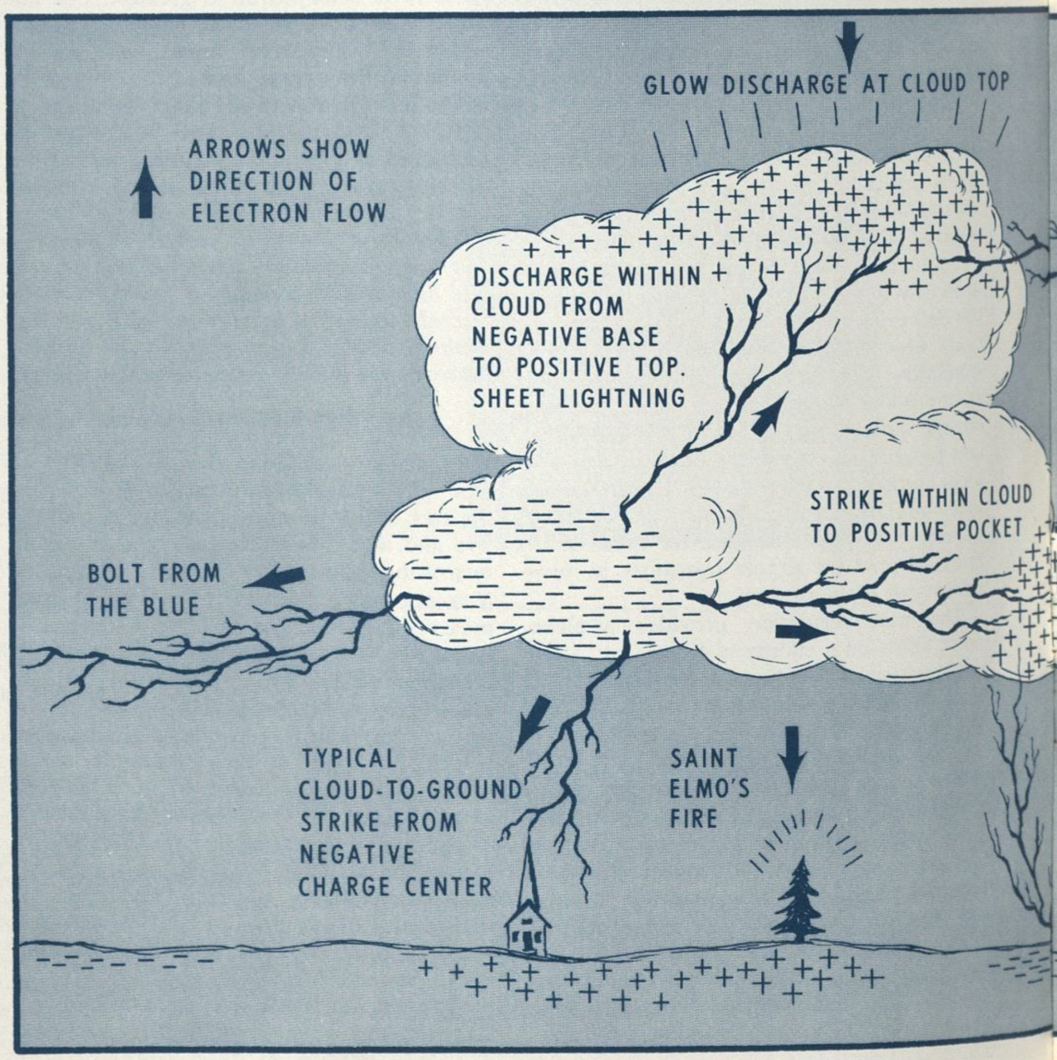
For some reason not fully understood, a daily peak of thunderstorm activity throughout the world occurs around 1900 GMT. Potential differences calculated at 20 to 100 million volts can exist between strongly charged areas in the thunderstorm itself, or between the cloud and the earth below. Currents in a lightning stroke are estimated at 10,000 to 200,000 amperes at its peak.

All clouds carry a positive charge at their top and a negative charge at their base, although a small pocket of positive charge also is located at the base.

The cumulo nimbus, with its familiar anvil shape, is the demon among clouds responsible for electrical violence aloft. (Other less distinctive cumulus forms can develop into a thunderhead in a matter of minutes.) When fully developed, the base of the "anvil" can extend over from 20 to 200 square miles of earth and range upward from 3,000 to 60,000 feet, and above. A thunderstorm appears to achieve its full electrical force when building cloud tops reach an altitude where the air temperature is about — 20° C. and when downdrafts

Lightning bolt starts with "step leader," a column of negative electrons descending from the cloud to meet the "welcoming" discharge of positive electricity from the ground.





and rain emerge from the cloud's bottom.

Speed Varies, Movement Erratic

While the exact nature of lightning remains something of a mystery to scientists, they are able, nevertheless, to describe fairly accurately how it travels between charge centers. A lightning flash does not travel with the speed of light and it does not move in a straight line. Its pattern is a stop-and-go, zigzag movement, at a speed estimated as slow as 130 miles a second to one-sixth the speed of light. The first impulse, called a "step leader," is a barely visible column of negative electrons. When the step leader nears the oppositely charged center, (another cloud or section of cloud or land mass) a "welcoming" discharge of positive ions reaches out to meet the leader. Following contact, a brilliant flashback, called the "return stroke", occurs. The process is repeated, with much greater brilliance, several times, usually three—but as many as 42 repeat strokes have been observed on one contact.

Cloud-to-ground strikes are only a small part of the total electrical display staged by thunderstorms, especially in hot, arid country where the distance from the cloud base to the ground is greatest. Most lightning discharges occur between and within clouds. The least frequent discharge is the "bolt from the blue"—with no apparent target.

Most weather scientists are of the opinion that aircraft do not attract lightning, but are struck accidently when they happen to stray into the path of a discharge. Most lightning strikes on aircraft leave a visible entry and exit point. The center of the aircraft is rarely struck; usually the nose or the wings are hit.

Knowing that he is not the intended target of Thor's thunderbolts is of small comfort to the pilot who does not wish to become an innocent victim. What can he do to keep his wings from being singed?

The simplest advice is to keep well clear of areas of reported thunderstorm activity. When it is not practical for him to do so, he should become alert for indications of precipitation static. Its growing intensity on low-frequency or VHF receivers identifies a highly charged airspace, conducive to lightning discharges. Another danger sign is the spectacle of St. Elmo's fire (illuminated displays of static electricity sometimes seen at wing or propeller tips), especially when occasional lightning is also seen in this area.

Outside air temperature appears to be a precipitating factor. Most recorded lightning strikes on aircraft have occurred when the outside air temperature was in the minus-to-plus 10 Centigrade range, with the heaviest concentration right around the freezing range, which corresponds to the charge separation level in thunderstorms.

Most Damage at Low Altitude

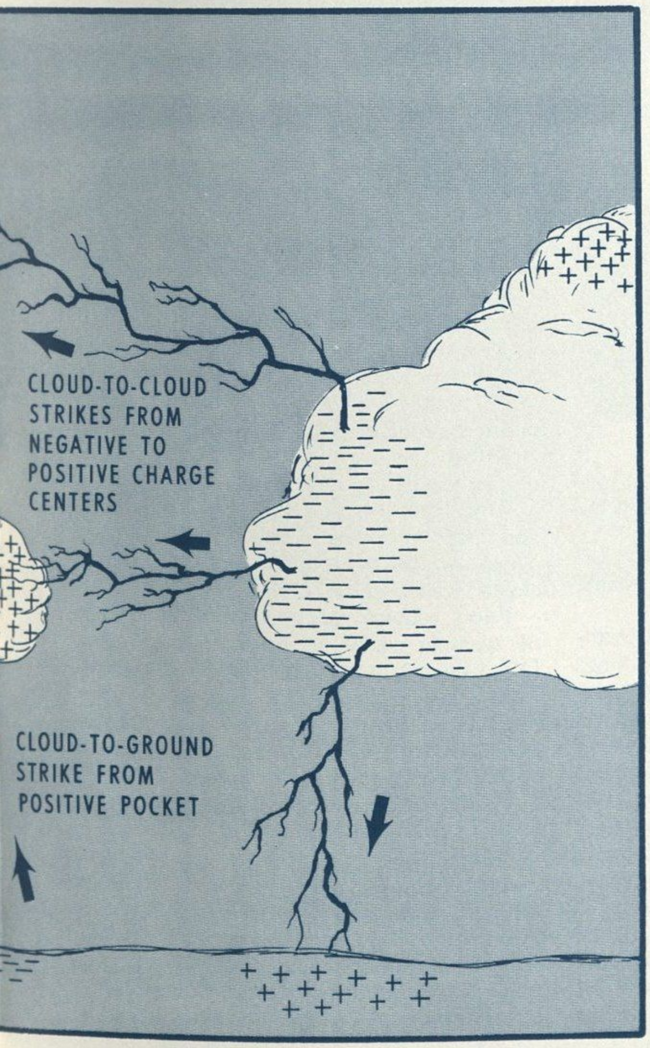
Lightning damage is a relatively low-altitude phenomenon. The majority of aircraft hits have taken place below 10,000 feet; very few hits have been reported over 20,000 feet. Lightning activity is generally confined to an area no further than 20 miles from the generating storm. Distance is also a limiting factor. So far, no lightning strike beyond 20 miles of a thunderstorm has been recorded.

An understanding of Weather Bureau terminology concerning thunderstorm activity is vitally important. For example, if during a flight a forecast of "scattered thunderstorms" (up to 45 percent of the area) is upgraded to a "numerous thunderstorms" category (up to 99 percent of the area), the weather picture has changed radically.

Pilots who fly frequently in bad weather are subject to a variety of superstitions and misinformation on the subject of what invites a lightning attack. A recent study of the Air Force's Tactical Air Command's occurrence of lightning strikes showed that a majority involved aircraft without radar or with their radar turned off.

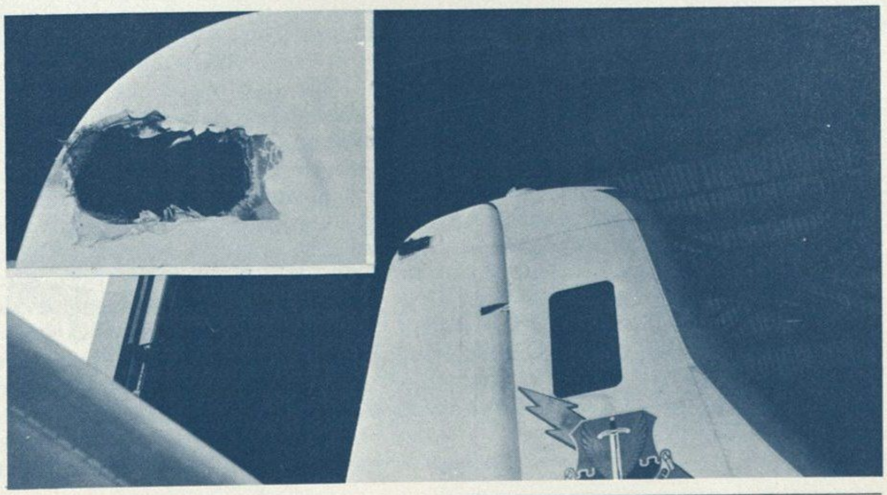
Neither airborne radar nor Air Traffic Control's ground based radar can guarantee a pilot immunity from lightning, but their intelligent usage, plus a general understanding of thunderstorm behavior and a healthy respect for the immense stores of energy hidden in the clouds, will go a long way toward reducing the hazard. ■

The original artwork and basic material for this article was provided by TAC ATTACK magazine, U.S. Air Force.



The intensity of static picked up on low-frequency or VHF receivers is one way to identify highly charged air. Another warning signal is the phenomenon known as St. Elmo's fire (illuminated displays of static electricity on wing or propeller tips).

Aircraft do not **attract** lightning but occasionally intercept it (below) when flying through highly charged airspace.



RAISINS in the SKY

Thunderstorms are best viewed from afar—and that is what airborne radar is all about. It provides a long look at the weather ahead, in some cases as far as 180 miles. Regular scanning can protect a pilot from blundering into a suddenly developed, fast-moving thunderstorm. Careful reading of the scope can provide a safe end run around a storm, or a safe passage between two storms.

Weather radar is required standard equipment in the 3,450 aircraft which make up the nation's air carrier fleet. This number is dwarfed by the estimated 8,000 general aviation aircraft which have weather radar units installed. The first commercially built airborne weather radar unit was installed in a corporate DC-3 in 1955. Despite price tags which range from $5,500 upward to $17,000, more and more general aviation aircraft are being equipped with weather radar.

In general, airborne weather radar operates in the same manner as a conventional ground-based radar—electronic pulses are beamed out from an antenna to strike whatever targets exist in the path of the beam. In weather radar, the targets are rain drops, hail (when covered by a thin layer of water) and wet snow. Pulses which strike these targets are reflected back to the antenna where they are amplified by a receiver and presented visually on a display in the cockpit.

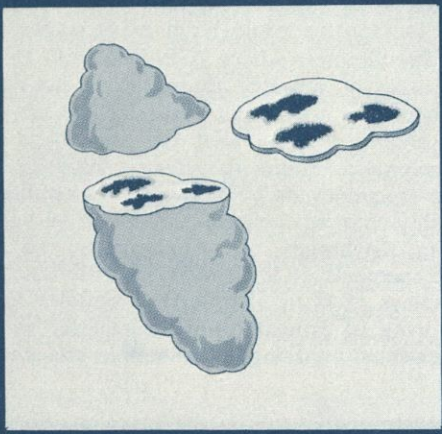
A key difference, however, lies in the sweep of the weather radar's antenna. Unlike ground radar which swings relentlessly around in a 360° circle, the weather radar antenna swings back and forth, 60 times a minute, covering a 120° sector (60° on each side) directly ahead of the aircraft. By means of a switch on the console, the antenna, which looks like a dish with a rod projecting from the center, can also be tilted up or down through a range of 15° to permit the radar to scan above and below the aircraft flight level.

Treat Radome with Respect

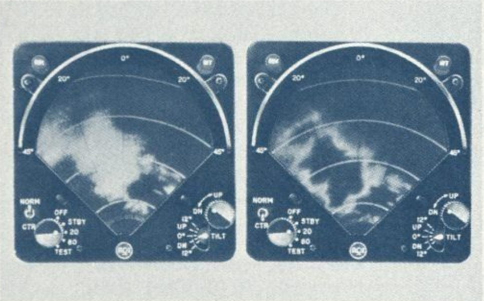
A radome, most commonly located in the nose of the aircraft, provides a streamlined shield or fairing, protecting the antenna from the weather and miscellaneous damage. Made of fiberglas because it (unlike aluminum) is 'transparent" to electro-magnetic energy, the radome is tough, but it can be damaged by impact and should be treated with respect.

The nose of the aircraft is the optimum location since it not only provides an unobstructed "look" at the weather ahead, but allows the antenna to be tilted down to permit the weather radar to be used as a navigation aid. In this application, ground features such as coast lines, rivers, different light values which show hilly or mountainous regions, large structures, and cities show up on the cockpit display.

A pilot flying at 20,000 feet can view a circular segment by tilting the reflector antenna 10° down. The ground area visible increases with altitude.



The faster aircraft fly, the quicker they can get into trouble—especially weather. Many aircraft are installing weather radar to help navigate safely around storms.



Left—normal mode radar return shows solid cloud. Right—contour mode discloses internal structure.

The nose is also the biggest space available to accommodate the relatively large antenna reflector dish. Even though experimental installations have been made placing the antenna in the nose section of tip tanks and under the wing of single engine aircraft, the nose of the aircraft remains the best location. For the present, this restricts weather radar to multi-engine aircraft.

The radar in the cockpit is a "plan-position indicator" (PPI), which paints a plan view of the storm on the face of the display. The "picture" is not a horizon view of thunderstorm cells ahead, the way the eye would recognize storm clouds. What the pilot sees is a cross section slice of the storm. An analogy may be made by comparing a storm cloud to a loaf of sliced bread standing on end. The radar beam can focus on a separate slice, "extracting" it from the loaf and presenting a view of the slice on the scope as seen from directly *above*.

By turning a "contour control" knob on the console case the pilot can get a look inside the cloud slice, a valuable safety feature since this will clearly show areas of greatest storm intensity. This can be compared to finding raisins in the slice of bread—where the raisins represent massive storm cells.

Typical airborne weather radar units have all the operating controls conveniently grouped on the instrument case surrounding the display scope. These allow for adjusting the set to one of three common ranges such as, 30, 60 and 90 miles. The range depends on such factors as antenna size, power and frequency.

"Day Vision" of Storm Possible

Development of the bright display storage tube (the cockpit "TV screen") has eliminated the hood which characterized the display console in earlier weather radar scopes. Thus, the radar return from a storm can be seen in brightest daylight. A simple adjustment knob is provided to interpose a screen which converts the conventional greenish signal into a deep red image for night viewing.

Storm distance from the aircraft, and the depth of the storm, is easily assessed by the use of electronically generated arcs (range rings) which extend across the face of the console.

The azimuth of a storm to the right or left of the flight path is readily determined by use of "degree" markings around the periphery of the indicator screen. Typically, these marks are scribed in five-degree increments which extend 60° to the left and right of the zero degree reference mark on the top of the instrument.

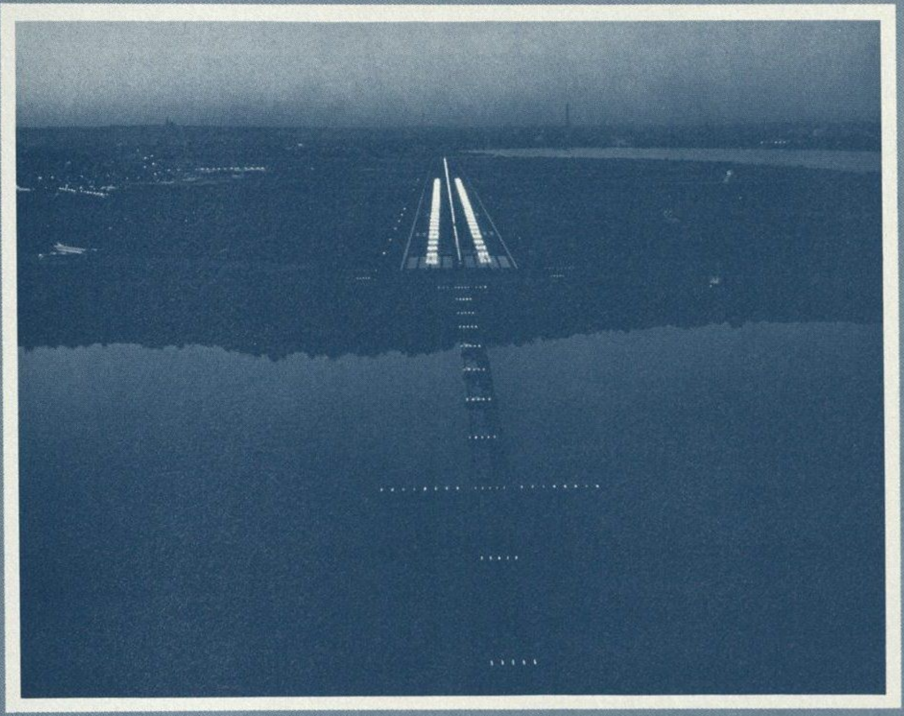
Thus, the direction and size of the storm, and the width of spaces between storm cells, can be determined by watching the storm system move across the screen.

Pilots require special training in the use of weather radar in order to obtain the full value in safety offered by the units. This may be obtained from the equipment manufacturer through correspondence courses. And at least one airline offers a one-day course which costs approximately $75. This course is generally offered during conventions and fly-ins.

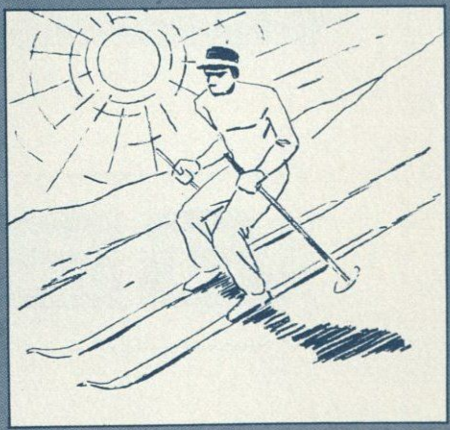
Aircraft equipped with weather radar are potentially safer aircraft—not because the radar enables the pilot to fly blithely through a storm, but because it gives him advance warning so that he can *avoid* it. Involvement with a thunderstorm is still a fearful experience, and one to be avoided. ■

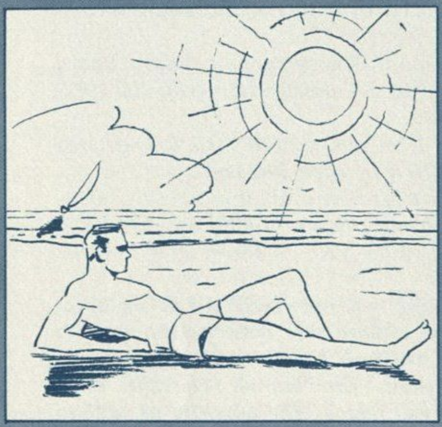
BLIND SPOTS II

• A new series of articles designed to familiarize pilots with environmental conditions that affect vision from the cockpit.



Seeing in the Dark





Several hours in strong sunlight can temporarily reduce a pilot's night vision. Remembering a few hints can help you avoid this problem.

If you have ever decided, while flying at night, that your night vision is certainly not what it was, you were probably right. The ability to see in the dark, on any given night, depends very much on how much bright light you have exposed your eyes to recently. Air Force medical officers estimate that a pilot can experience a 30 to 50 percent reduction in his night vision, as a result of several hours exposure to bright sunlight, especially in a light-covered environment, such as sand or sea or snow. The effect is cumulative, and repeated exposure may leave you with night-poor vision for as long as a week. Recovery normally follows simply as a result of resting the eyes or protecting them from bright light, but restoration of visual powers is a gradual process. Don't expect good night vision after a day on the beach or the ski slopes.

In any event, if you are a pilot who flies at night occasionally, you will do well to form the habit of carrying sunglasses at all times and wearing them whenever the sunlight is strong.

Other factors which affect night vision are fatigue, inadequate oxygen, cigarette smoking and distraction from bright lights or reflection in the cockpit. The use of red light for cockpit illumination may be helpful, and flashlights with red filters are available. Under these circumstances, of course, it is not possible to read any kind of marking or charting in red.

Advancing years, beginning usually about age 40, bring about a weakening of night vision, but eyes that are properly protected during the day will at least give you their full measure at night. ■

Penetrating the airport control zone when visibility is less than three miles always requires an IFR or Special VFR clearance (where permitted) and extreme vigilance.

This is the first in a series of articles on recent midair collisions in VFR flight. FAA AVIATION NEWS is drawing attention to this particular type of accident because it has shown a sharp statistical increase in recent months. Thirty-eight midairs were recorded in 1968, a 46 per cent increase over the 1967 figure of 26, and adverse weather was not cited as a significant factor in any of the accidents.

A National Transportation Safety Board study of the 38 midairs occurring in 1968 notes that:

(a) At least one general aviation aircraft was involved in each incident.

(b) Most occurred at or near an uncontrolled airport, below 5,000 feet in VFR weather during the summer and on the weekend.

(c) Traffic was not congested in the area.

(d) The closure rate between the aircraft involved was well below cruise speed.

Conclusion: the human element is a major causal factor. The majority of victims departed from safe flying techniques and/or existing flying rules.

SEEN and

A typical and shocking example is the midair collision that occurred at 11:10 a.m., June 14, 1969, over Long Island Sound just off Waterford, Conn.

Reconstructed, the incidents that led up to the tragedy were:

7:40 a.m. A private pilot, 45 years of age, with 365 hours of flying time, planned a flight from Trumbull Airport at Groton, Conn., to Detroit. He was flying a Beech Debonair and had three passengers aboard. He requested a weather briefing from his nearest flight service station, located at Windsor Locks, near Hartford. Windsor Locks reported the ceiling indefinite, with obscuration; and visibility at one and one quarter miles with fog. He did not depart at that time, presumably waiting for the weather to clear.

9:46 a.m. The pilot obtained a second weather briefing and filed a VFR flight plan from Trumbull, changing his destination from Detroit to Buffalo, New York, at a proposed altitude of 8,500 feet, cruising at 135 knots true air speed.

10:10 a.m. The pilot departed Trumbull Airport. At this time a cold front, about 180 miles west of Trumbull, lay across the pilot's proposed course from northeast to southwest. A line of thundersqualls lay east of the front.

10:30 a.m. Another pilot, 37 years old with a commercial certificate and 1,570 hours of flying time, departed Linden Airport, Linden, New Jersey, bound for Westerly Airport, about 12 miles due east of Trumbull. He was carrying four passengers aboard his Piper Apache. He did not file a flight plan and there was no communication between Air Traffic Control and the flight enroute.

11:00 a.m. Groton/Trumbull was reporting 300 feet scattered clouds, 600 feet broken clouds, visibility two miles, fog, temperature 71°, dew point 68°, wind 220° at eight knots, altimeter setting 30.04.

11:09 a.m. The Debonair pilot, encountering IFR weather over Pawling, New York, turned back toward Long Island Sound. He approached Trumbull from a southeasterly direction and radioed Providence Flight Service Station, requesting a special VFR clearance to re-enter Trumbull airport control zone and return to that airport. The flight was cleared as requested and the pilot was advised to report when the airport was in sight. There were no

UNSEEN

further communications with the Debonair flight.

The National Transportation Safety Board investigators surmised that the Apache pilot probably encountered the same low cloud ceiling over the Long Island Sound that forced the Debonair pilot to turn back to Trumbull. Knowing that friends of the Apache's occupants were anxiously awaiting their arrival at Westerly, a scant 15 miles from where he encountered weather, the Apache pilot apparently decided to continue his flight rather than fly the 100 miles or more back to Linden.

It appears that he veered north slightly in order to keep the Connecticut coast in sight, while flying toward Westerly. In any event, it is clear that the Apache pilot penetrated the Trumbull control zone in poor weather conditions which required either an IFR or a Special VFR clearance. Neither was obtained.

11:10 a.m. The Apache and the Debonair collided in midair at an approximate altitude of 300 feet over a point about 1,500 feet offshore near Waterford, Conn., and 4.3 miles south-southeast of Trumbull Airport. Each aircraft was demolished. All nine persons on board the two aircraft were killed.

A witness who observed the accident from the deck of his fishing boat anchored in the Sound, described the accident as follows:

"I first observed the twin engine aircraft (Apache) to the west of my position on a course I would estimate to be 110-110° (actually 72°). Several seconds later I saw the single engine aircraft (Debonair) southwest of my position and it was on a northeasterly course. I could immediately see that the two aircraft were on a collision course but I thought to myself that they must have seen each other and I also thought the single engine aircraft would pass beneath the other . . .

"One or two seconds before the impact, the single engine aircraft made a very, very steep bank to the right (about 80-90°) in an effort to avoid the crash. The twin continued straight ahead and the starboard wing and engine of this aircraft initially impacted with the underside and lower belly of the single engine in what appeared to be the cabin section.

"The engine then seemed to buckle in half and the nose and engine turned left almost 90° to the fuselage section of this aircraft and it then struck the left front of the twin in the nose cowl area. The twin then yawed to the right and began to cartwheel coming completely apart in the air. The single engine also broke apart and both aircraft then fell into the water about one-third of a mile from shore a little less than one quarter mile from me. . . ."

Post mortem examination of the pilots disclosed no evidence of any physical condition, such as intoxication, related to the cause of the accident.

The National Transportation Safety Board gave as probable causes: failure of the Apache pilot to follow approved procedures and directives, and failure of both the Apache and the Debonair pilots to see and avoid other aircraft.

Both pilots were instrument rated, but neither had elected to fly IFR under radar protection. The tragedy is a sober warning to all who fly of the extreme vigilance and constant scanning which safe flight demands, *especially under conditions of restricted visibility.* ■

RIGID ROTATION:
Gyroscopic Instruments

WHEN Lawrence B. Sperry and his father, Elmer, moved their gyroscopes out of ships and put them into airplanes in the early 1900's, they opened the door to instrument flight.

The heart of their device was the rotor which exhibited a stubborn but expected tendency to remain in its plane of rotation, in response to Newton's laws of motion, regardless of which way—up or down, right or left—the aircraft deviated from its course. This stability in relation to the earth may be used to navigate an aircraft without visible reference to the ground.

Today, the gyro remains the key component of three of the basic flight instruments: the heading indicator (gyro compass or directional gyro), the turn and bank indicator (needle and ball), and the attitude indicator (artificial horizon).

Gyros can be driven by vacuum pressure or electrically, each method having its advantages and disadvantages. Electrical gyros cost more and are generally found in newer, high performance aircraft. In some cases, both types of gyro instruments are installed in a single aircraft, the attitude and heading indicators being driven by vacuum, and the turn needle driven by electricity.

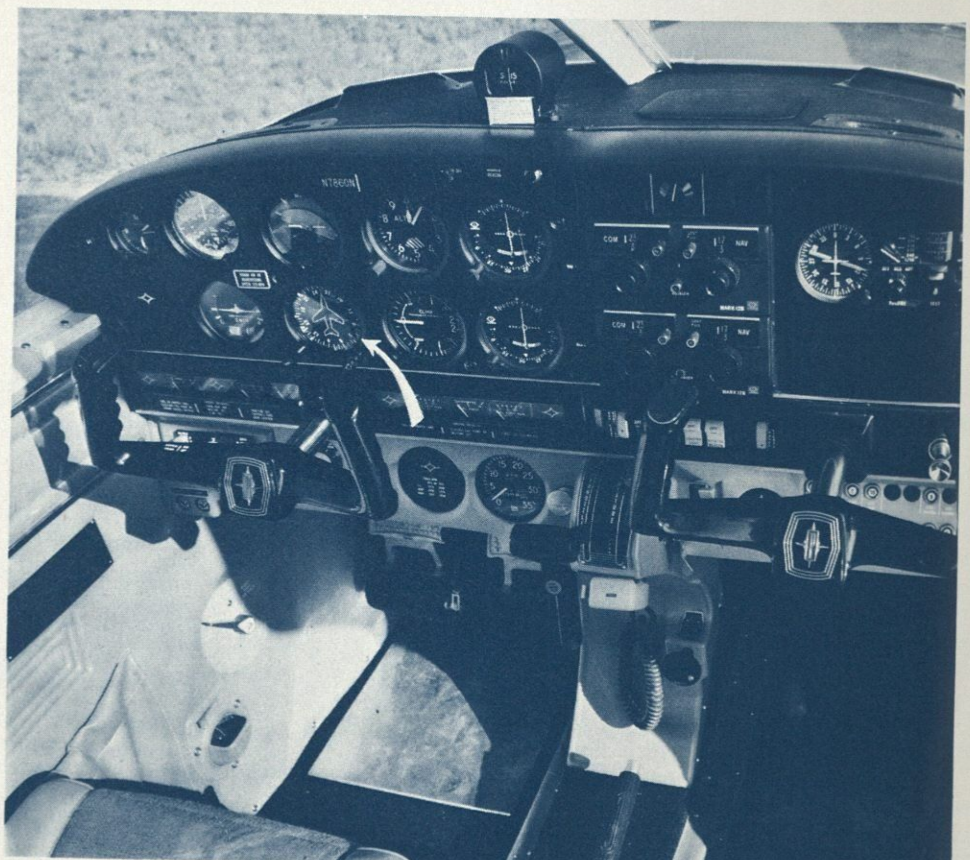
Battery Powered Indicator

With such an installation, if the vacuum system or the engine fails, the most important of the three instruments, the turn indicator, will continue to operate on current supplied by the battery. Interestingly enough, the Sperrys' original aircraft gyros were electrically driven.

The vacuum "pressure" (it is actually the absence of pressure) to drive gyros can be derived from two sources, a venturi tube mounted in the slipstream outside the fuselage or an engine driven vacuum pump. Except for aircraft which are now approaching the antique category, the venturi installation has disappeared. To be effective it had to "rush" through the air at nearly 100 mph under standard sea-level conditions. Variations in aircraft altitude and speed resulted in unreliable performance, and since no vacuum was created unless the aircraft was moving through the air in flight, such gyro instruments could not be preflight tested on the ground.

The venturi gave way to the engine driven pump, which produced a dependable and controllable vacuum, or sub atmospheric pressure. (The engine driven vacuum system has still another advantage—the exhaust side of the system provides the pressure to operate pneumatic deicer boots on wings and tail surfaces.)

The engine driven vacuum pump sucks air from the rear of the instrument case,



Directional gyro (arrow) must be reset according to the magnetic compass every 15 minutes in flight, while the aircraft is flying straight and level.

causing air under atmospheric pressure to enter the case through a filtering system. This air passes through the hollow gimbal ring and is directed against the rotor by nozzle jets.

The revolving speed of the rotor may vary from 10,000 to 18,000 rpm, depending on instrument design. For proper operation, the suction guage reading can be as low as 3.5 and as high as 5.0 inches of mercury, with 4.0 the ideal reading.

Vacuum Pump Efficiency Varies

As aircraft, including the general aviation fleet, began to fly faster and higher, the engine driven vacuum system began to show inadequacies. At 18,000 feet, with atmospheric pressure approximately half that of sea level, the vacuum pump is about half as efficient as at sea level. The efficiency of the vacuum driven gyro continues to fall off as altitude increases, and it is further diminished by the effect of low temperatures on bearing oil viscosity.

The vacuum pump system is also vulnerable to contamination from the air brought into the instrument case. Filters should be changed regularly, usually at 100-hour flight intervals, or oftener if flight is carried out under very dusty conditions. In addition, tobacco smoke in the cabin leaves a tarry residue on rotor bearings and affects efficient operation.

The electrically driven gyro is hermetically sealed, effectively preventing outside contamination. The rotor in an electric gyro is actually the armature of a small electric motor—it is the gyro mass. Whether driven by electricity or air, the rotor responds to the same principle; a spinning mass tends to remain stable in its plane of motion in relation to the earth.

Gyro Spins on Horizontal Axis

This basic law of physics, which is familiar to anyone who played with a toy gyroscope as a child, provides the pilot with a compass which does not lag or fall behind in a turn, climb or dive. The directional gyro spins on a horizontal axis which holds its position regardless of the aircraft's attitude. A cylindrical scale like that on the magnetic compass is attached to the vertical gimbal, and read through a rectangular window in the dial. In effect, the airplane as it changes heading moves around the stationary compass card. A manual knob is provided for setting the proper direction into the directional gyro. Pushing the knob ("caging the gyro") clamps the gimbals and gyro and engages a gear mesh. Turning the knob permits the pilot to rotate the entire assembly to the correct direction. The knob is then pulled out ("uncaged") for normal operation.

Because of slight gyro friction and unbalance, earth rotation and other factors, the gyro will drift gradually from its setting. In flight it should be caged and reset about every 15 minutes. An error of no more than three degrees in 15 minutes is considered normal. Some advanced types of gyros have been developed which use a magnetic sensing device to automatically realign themselves.

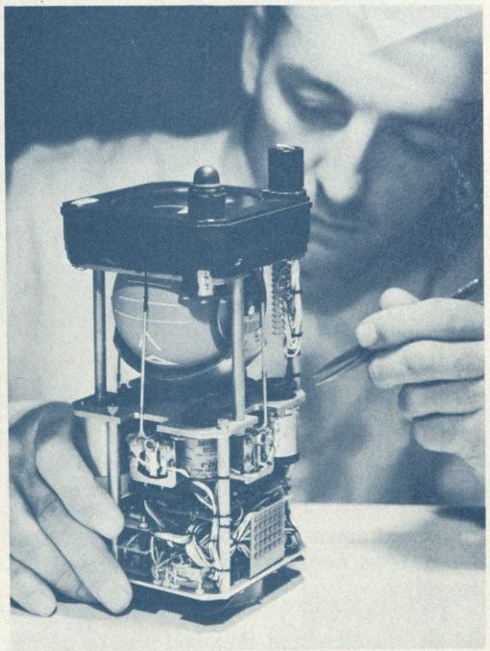
The gyro compass may also be set just prior to takeoff, if the pilot is able to align his aircraft with a known direction, such as the runway.

Some pilots are in the habit of caging the gyro and leaving it in this condition while taxiing or landing, in the mistaken belief that caging the instrument protects it from bumps or landing shocks. In point of fact, the opposite is true. A caged gyro is much more likely to be damaged on the ground than an uncaged one that is able to move freely in its gimbals. *Never leave the instrument caged except when shipping it or when preparing to engage in aerobatic maneuvers.*

The operating limitations of the vacuum driven gyro compass are 55° of pitch or bank; for the electrically driven indicator, the limits are 85° of pitch or bank. Exceeding these limits causes the instrument to strike the limit stop (possibly damaging the bearings if the maneuver is sufficiently abrupt) and spin rapidly. This may be corrected by caging, resetting, and uncaging the gyro.

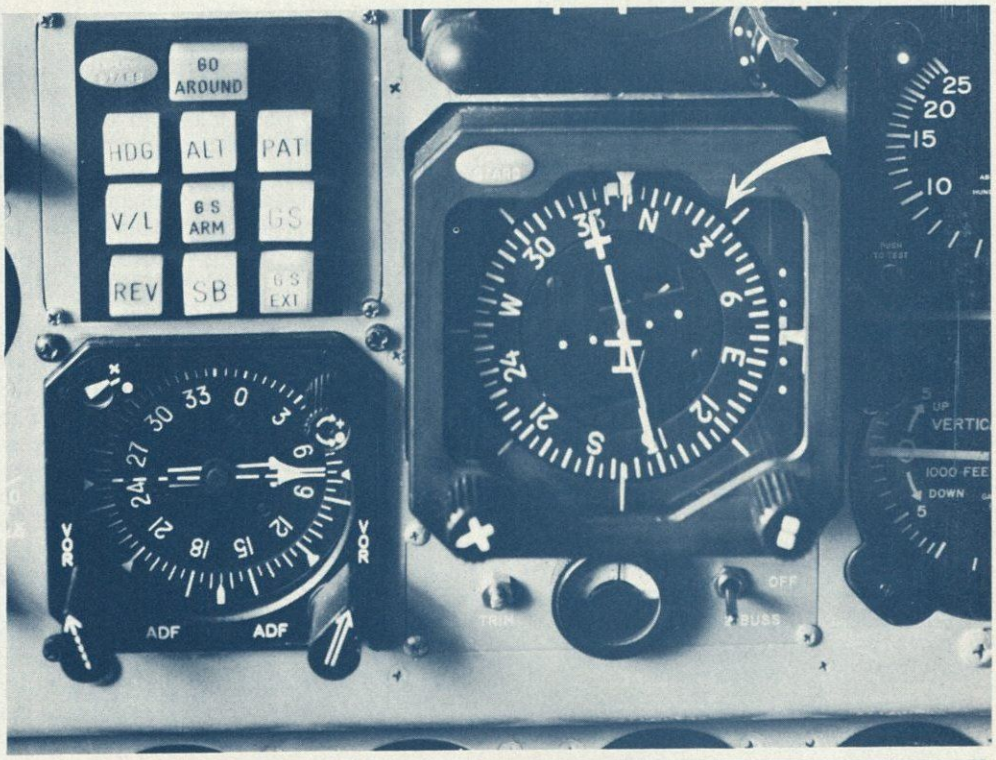
Some apparent malfunctions of the gyro may be traced to misuse of the magnetic compass when the directional gyro is set. Unless magnetic deviations are applied, the indicator may appear to drift several degrees after a turn is completed. Another common error results from failure to maintain straight-and-level flight while setting the directional gyro to the magnetic compass. Errors in the latter instrument are thus duplicated in the heading indicator. ■

(First of a two-part article on gyro instruments. The second article will discuss turn and slip indicators and horizon gyros.)



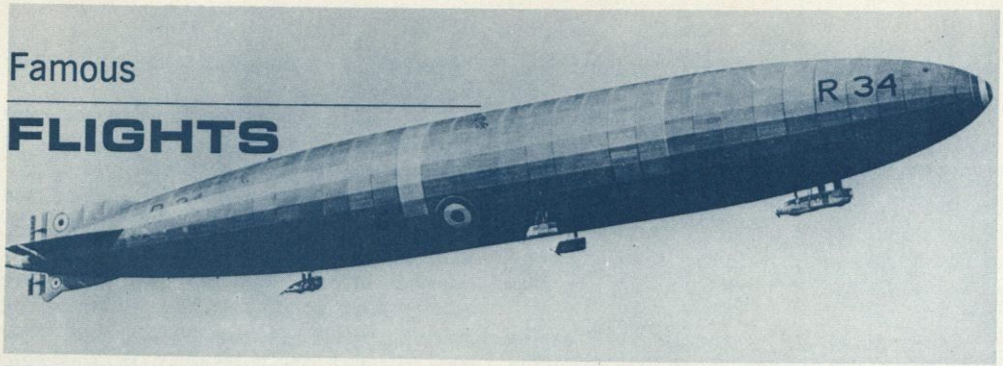
Right—for repairs, the gyro must be removed from the aircraft and shipped to the manufacturer. The instrument should always be caged before shipment.

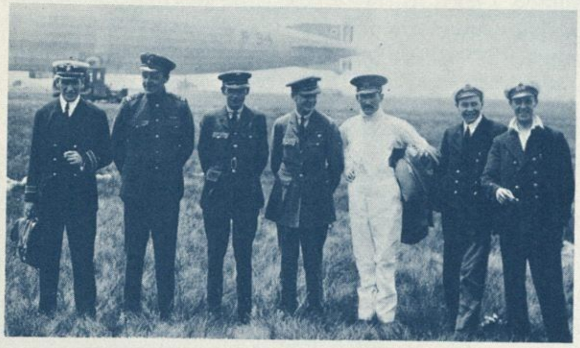
Below—an error of drift of no more than three degrees in 15 minutes is considered normal in gyros. Some apparent malfunctions are caused by the misuse of the magnetic compass when the directional gyro (arrow) is set.



Famous

FLIGHTS





Happy and safe at the completion of their adventurous flight, with the mammoth British craft carefully docked, are (left to right) Lt. Commander Landsdowne, USN, as observer with flight officers, Major J. E. Pritchard, RAF; Lt. Guy Harris, RAF; Maj. J. E. Luck, RAF; Lt. J. D. Shotter, RAF. The giant airship carried thirty crewmen on the trip. Photo by Keystone View Co., N.Y.

FIRST TRANSLANTIC EXCURSION

The historical prominence of aviation "firsts" is subject to the whims of chance and public response. Otherwise it would be difficult to understand why Alcock and Brown's Vickers Vimy is enshrined among the well known aviation relics while Major G. Herbert Scott and the R-34 are all but forgotten.

The year was 1919, when the ambition of all who flew and dreamed was to be the first to fly the Atlantic. In June of that year Alcock and Brown completed the first nonstop crossing by flying from Newfoundland to Ireland, where they crash landed in a bog. They were showered with national honors and split a cash prize of 10,000 British pounds (then about $50,000.00). A month later the R-34 carried *thirty* crewmen from Scotland to New York, the longest nonstop flight (3,130 nautical miles) over water on record. A few days later they flew back to England without incident and all but disappeared into the oblivion of time.

Perhaps the principal reason why the R-34 is no longer remembered as an aviation pioneer is that it was a dirigible, and in the development of aviation over the past 50 years lighter-than-air craft have almost disappeared from the scene. Driven by five engines, the R-34's silver hull measured 643 feet over all. Built originally as an answer to the German Zeppelin fleets which bombed England during World War I, the British craft was commissioned too late to take part in the war.

Except for the German's recalcitrance in signing certain articles of peace, the R-34 might easily have been the first aircraft of any kind to cross the Atlantic in any direction. But in May, 1919, the British Admiralty sent the dirigible on an extended, 2,400-mile flight up the Baltic and along the German coast to prod the Germans into action.

Once this tour was over, in late May, the R-34 was transferred to the Royal Air Force and preparations for her transatlantic flight were pushed.

The flight got under way at 1:30 a.m. on June 2, 1919, when the dirigible, already loaded with 16 tons of fuel, provisions and crew, was pulled out of its shed at East Fortune, near Edinburgh. The wind was brisk and the night was made blacker by a drizzle and low hanging clouds. Smartly, the ground crew manhandled the ungainly craft away from the hangar and almost immediately the commander, RAF Major G. Herbert Scott, cast off.

Within 1,000 feet of the ground, the dirigible was swallowed up in an overcast and remained so hidden for most of the journey. Early in the flight Scott decided to keep at least one engine idle whenever possible in order to conserve fuel, but even with reduced power, the log was later to show that the huge aircraft averaged 56 mph. The east-to-west-crossing was considered far more difficult than west-to-east because of prevailing westerly winds.

Their course took them over the Irish Sea and as dawn broke they could see the Irish coast and beyond it the Atlantic. By 4 p.m. they had left Ireland 600 miles to the east.

For most of the flight, the R-34 was either flying through solid fog or running between layers of clouds, never more than 1,500 feet above the ocean. Occasionally, a hole would open, sometimes to the sky above or the sea below, and the skipper and navigator would make hasty computations as to drift, speed and position. On July 3, the skies dawned clear overhead and the officers were able to get their bearings, but they were still above a thick blanket of clouds.

On July 4, the cloud cover became patchy and the crew caught glimpses of sea ice and flew over an enormous icefield, necklaced by icebergs. A few hours past midnight, the R-34 passed over Trinity Bay, Newfoundland, just 59 hours after lift-off from East Fortune, Scotland.

Major Scott's staff included an American "official observer," Lt. Cmdr. Zachary Lansdowne, as well as British Major John Pritchard, destined to become the first man to land on American soil from the air. Scott was also accompanied, without his knowledge or permission, by crewmember William Ballantyne, the first stowaway in aviation history, and his cat. Ballantyne had been stricken from the roster at the last minute to allow more fuel to be carried, but he managed to slip on board unnoticed. On his discovery, over the broad Atlantic, there was some discussion of dropping him over the side, with or without parachute, but this was viewed as bad luck and Ballantyne and cat remained on board.

Enroute, the crew lived well, considering the lack of refrigeration and cooking facilities. The dirigible was well provisioned with cold beef and ham, hard cooked eggs, steak pudding and tea, the latter two served hot through an ingenious oven which used the engine exhaust manifold for heat. Hot bouillon and coffee were also produced in the same fashion.

When the R-34 started down the eastern

Major G. H. Scott, RAF (center), in front of the R-34 he commanded, discusses the flight characteristics and problems of the huge blimp with United States Air Corps officers after his historic trip.

seaboard of the U. S., the weather became increasingly turbulent, with sudden massive updrafts which pitched the dirigible upward, sometimes hundreds of feet in one surge.

Because of the fuel shortage, a landing was scheduled at Boston. The U.S. Navy was asked by radio to have a destroyer trail the dirigible, and possibly tow it to New York if necessary.

Then the wind changed, and for a time the dirigible was pushed along by a mild tail wind. Major Scott was able to shut down one engine to conserve fuel, and a decision was made to continue on to New York. But the shift in the wind came too late to recall the British chief of the ground handling crew, who had been dispatched from New York to Boston to supervise berthing of the R-34.

With two of her five engines shut down to conserve fuel, the British dirigible slipped westward like a ghost through the early morning skies off the east coast of Long Island, N. Y. July 6, 1919, was dawning in a sulky mood with low-hanging clouds and wisps of fog reaching down to the rolling Atlantic.

The silver airship slowly approached Mineola and its planned landing site at nearby Roosevelt Field. Leaning half out of the open windows of the control cab, Maj. Scott and his American observer, Lt. Cmdr. Lansdowne, searched anxiously for landmarks as the sea glided past 400 feet below. They were nearing the end of a perilous four-and-a-half-day journey, but the difficult task of mooring remained.

Wig-wag signals from the ground at Roosevelt Field confirmed that while a force of 600 or more stood by to help moor the R-34, most of them were inexperienced, and they had no leader. Major Scott made a decision—Second Officer Pritchard was to descend by parachute and take over docking duties.

Pritchard left the dirigible at 2,000 feet, his parachute snapping open immediately, and he was on the ground in about two minutes, landing rather heavily and slightly injuring his hip. The time was 9:19 a.m., July 6, 1919. Maj. John Edward Maddock Pritchard, RAF, became the first person to land in America from an aircraft.

After two days of official visits, partying, and making the R-34 ready, the huge dirigible cast off at 11:15 p.m., July 9. She sailed low over Broadway where anti-aircraft searchlights lit her like a huge phosphorescent mammal. Seventy hours later, after an uneventful flight, the R-34 arrived at Pulham, England.

The first round trip excursion by air across the Atlantic was over. The stage was now set for the day when giant airliners would crisscross the oceans daily with little concern for wind or weather.

Pilot BRIEFS

• ALL AROUND LOCALIZER ANTENNA ARRAYS. FAA has contracted with Andrew Alford Consulting Engineers of Winchester, Mass., to develop three ILS localizer antenna arrays that would give optimum airborne performance in both simple and complex airport environments.

Localizer signals (which provide aircraft on instrument approach with lateral guidance to the centerline of the runway) are affected by reflections from environmental factors such as buildings, hangars, powerlines or other metallic surfaces, which are configured differently at each airport. The contract will endeavor to establish three basic arrays which will function with minimum disturbance in the appropriate environment.

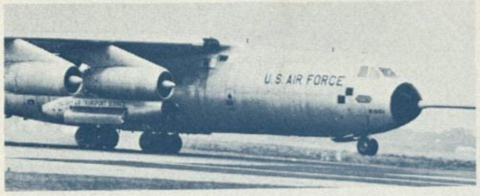
Equipment developed by the contractor will be checked at FAA's National Aviation Facilities Experimental Center (NAFEC) and later field tested at selected problem sites.

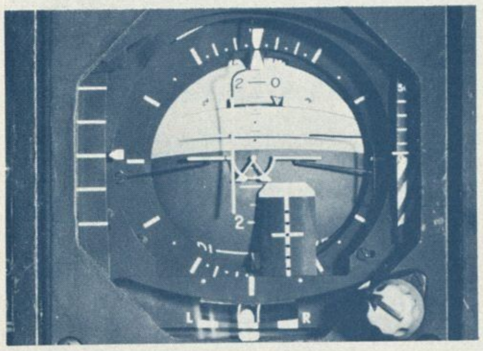
• OREGON PILOTS ADOPT A PUP. Members of the Hillsboro, Ore., chapter of the Oregon Pilots Association have sharpened their aeronautic currency, thanks to a unique, association-originated pilot upgrade program (PUP) that keeps tabs on their proficiency and tells them where their skill needs to be polished. The PUP calls for a flight check and a scoring system on a 45-item check list that makes up a pilot's flying "profile." In addition to flight check items, the profile includes checks on pilot current medical certificates, log books, radio operator's license, annual aircraft inspection, pilot certificates, and aircraft and engine log books.

• MINIMUM FLIGHT TIME FOR ATP INCREASED. New rules which went into effect on November 22, 1969, alter the aeronautical experience requirements for airline transport pilot certificates. A principal change increases the minimum required flight time while giving more credit for flight time logged by co-pilots and flight engineers in air carrier operations.

An ATP certificate now calls for 1,500 hours of flight time instead of the previous 1,200. However, a pilot with a commercial certificate may now log all second-in-command airline flying time toward his ATP certification. If he participates in an FAA approved airline pilot training program, he may also credit a portion of flight engineer flight time, when such time was acquired in transport planes operating in air carrier service in which flight engineers are mandatory.

Other changes include deleting the currency-of-experience rule that required all accredited flight time to be logged within eight years prior application for the ATP certificate. A new provision substitutes one night takeoff with a full stop landing for each hour of the 100 hours minimum required night flight time. This substitution will be allowed when the applicant has already made 20 night takeoffs with full stop landings. No more than 25 hours may be substituted for in this manner.





Above—aircraft fuel fire was quickly extinguished by a foam blanket in a new technique described in the technical reports listed below.

Left—horizontal gyro is key instrument in all weather landing system which brought this Air Force jet down under electronic control.

New Technical Reports on ILS, Runway Sealants, DME

The Federal Aviation Administration has made available to the public eight new technical reports covering a broad area of aeronautical knowledge.

Included in the new list are technical reports on an all-weather landing system attitude director indicator system, a runway sealant for bituminous runways, the effects of terrain and snow on instrument landing system (ILS) glide slopes, extinguishing agents for fighting fuel fires, antenna arrays for use in satellite communications tests, and the capture effects of ILS receivers.

"Distance Measuring Equipment for Terminal Areas", (AD 686 841), discusses the feasibility of low-power, low-cost, all-solid state DME for smaller terminal areas, its co-location with TVOR and ILS and its use in V/STOL operations.

"Attitude Director Indicator System for FAA All-Weather Landing System", (AD 691 183) discusses a cathode ray tube display, development of the system, theory of operation, system description and operating controls for the indicator and control unit.

"Sealants and Saw Kerfs in Flexible Pavements," (AD 683 760), describes FAA experiments with over 40 different sealant materials to determine the most effective seal for saw kerfs in bituminous runways to accommodate in-runway lighting systems.

"Theoretical and Experimental Investigation of Parasitic Loop Counterpoise Antennas," (AD 680 289), describes parasitic loops that could be used to improve the performance of antennas now used in VHF Omni Range (VOR) systems. Three antennas were proposed in the study.

"Earth Cover Contour Effects on Image Glide Paths, Phase III," (AD 690 461), contains recommendations for alleviating or eliminating the effects of terrain contours and snow accumulation which can produce ILS glide path irregularities.

"Foam and Dry Chemical Application Experiments, Interim Report," (AD 680 068), lists the time required to control various sizes and types of fuel fires using six foam and three dry extinguisher agents, quantities and discharge rates.

"Aircraft VHF Antenna for Satellite Communication Tests," (AD 678 954), describes details of FAA's plans to evaluate the capability of the ATS-B satellite to relay VHF voice communications between air traffic controllers and pilots flying over oceanic and sparsely populated land areas.

"Study of Two-Frequency Capture Effects on ILS Receivers," (AD 685 638), discusses the use of capture effects to reduce the performance deficiencies of two-frequency ILS.

Copies of the studies are available from the Clearinghouse for Federal Scientific and Technical Information, 5285 Port Royal Road, Springfield, Va. 22151. To order the technical studies, list the title "AD" number, and enclose a $3.00 check or money order for each hard copy volume or 65 cents for each microfiche copy, made payable to the Clearinghouse.

Detection System to Curb Sky-Jackers

Would-be aircraft hijackers now face the possibility that they will be halted and searched even before they can board the plane, thanks to an anti-hijacking system developed by the FAA and now in use at key airports in the U. S.

The system combines knowledge of certain behavioral traits common to hijackers, as developed by a special FAA task force, with a weapons screening device. Several thousand passengers were screened by the system during field trials in nine cities without complaint or inconvenience.

Under the law, hijacking can result in a minimum jail term of 20 years, and carrying a concealed weapon can bring a one-year term and a $1,000 fine.

Over 38,000 Veterans Have Enrolled In Flight Training Under G.I. Bill

More than 25,700 exservicemen were taking advanced flight training under the G. I. Bill as of Nov. 1. Since flight training was approved by the Veterans Administration in October 1967, 38,588 veterans have taken advantage of the law to upgrade their aeronautical qualifications.

Primary prerequisite for eligibiljty, aside from bona fide veteran's status, is a private pilot's license. In addition, a candidate must meet medical requirements for a commercial license.

The flight course must be certified by the FAA and it must also be approved by the state approving agency in the state where the school is located.

Eligible veterans are paid an educational allowance computed at the rate of 90 per cent of the established charges for tuition and fees which non-veterans enrolled in the same flight course are required to pay.

The veteran will be charged one month's educational entitlement for each $130 which is paid to him as educational assistance for a flight course.

WOMAN'S TOUCH Mrs. Joan Steinberger, perched on the wing of her plane, recently was awarded the FAA/DOT Award for Distinguished Service for assisting another woman pilot in making a safe landing under emergency conditions. Mrs. Steinberger unselfishly forfeited her chances of winning the 1969 All Woman Transcontinental Air Race when she went to the aid of another contestant who became disoriented in a thunderstorm. The troubled aviatrix was not only low on fuel but was without two-way radio contact with the nearest control tower. Under Mrs. Steinberger's expert tutelage, the lost pilot landed safely—and ran out of fuel while taxiing.

FAA Aviation News welcomes comments from the aviation community. We will reserve this page for an exchange of views. No anonymous letters will be used, but names will be withheld on request.

• After the Fact

Your "Famous Flight" article in the September *FAA Aviation News* concerning the first fully automatic landing was interesting but surely should acknowledge the work completed by the Royal Air Force at Bedford in recent years. This work resulted in *Trident* type aircraft in the British European Airways fleet making fully automatic landings, including automatic flare-out, in scheduled service (in good weather only) for more than three years.

The first B.E.A. landings were made in 1965 and since that date more than 100,000 passengers have been landed automatically.

P. C. C. Brown
Mountainside, N. J.

• Hybrid Nav Systems

Our group at Massachusetts Institute of Technology is looking into the performance of hybrid navigation systems but so far we have not been able to find any data regarding the actual accuracy of these systems as tested.

We are particularly interested in the following navigation systems: VOR-DME (conventional); TACAN; LORAN-A; LORAN-C; DECCA; PAR.

Has FAA published results of tests of any of these systems and are the results available to the public?

Dan Dayal Bansal
Cambridge, Mass.

The reports you are interested in are grouped under "Navigation" and are available for $3 a copy from the Clearinghouse for Scientific and Technical Information (CFSTI), Springfield, Va. 22151. Your University library should have a copy of the CFSTI semi-monthly publication "U. S. Government Research and Development Reports." Annual subscription is $30 and a single copy is $3.

When ordering publications from CFSTI care should be taken to use the correct title and "AD" designator.

• Combined Training

As a private pilot now taking flight training under the GI Bill, I would like to know why the commercial and instrument rating cannot be taught as an integrated curriculum. As of now, you must first obtain a commercial pilot's license before beginning another flight training program.

I realize 200 hours are necessary for instrument qualification, but as a private pilot going into a GI Bill program you will have at least 50 hours and only 160 hours are required for the commercial ticket at a VA school—so you are 10 hours over the minimum.

It would be a simple matter to combine the two: it would cost less, by about $500 to $800 depending on the individual, and it would put a better qualified pilot into the air traffic system.

Lawrence C. Bignall
Cleveland, O.

A number of combined training courses for the commercial pilot certificate and instrument rating have been approved by the various FAA Regions and state approving agencies. The Veterans Administration has advised the FAA that a veteran who is otherwise eligible may receive financial assistance while enrolled in such courses. The VA also advises that such assistance for both courses cannot be authorized to a veteran enrolled in two separate flight training courses at the same time.

• Pilot to Tower

(Editor's note: Dr. James R. Hendon, a physician in Louisville, Ky., sent the following letter to personnel at the various flight service stations and towers he had utilized during his flying activities last year.)

You and I may never have met, though we have certainly held interesting conversations to which I paid the most profound attention. You helped me to find a hole in an undercast when I was beginning to glance a little more frequently at my gas gauge. You lighted the field for me one dark gray afternoon so that I might find it more easily. You warned me about the thunderstorm that churned the air across my flight path.

You went to no little trouble to find me and restore my orientation when I was quite lost, and you led me gently and surely to the welcome sight of the runway.

All these things and many more you did for me and many another aircraft, and always with great patience and solicitude. In fact, help and assistance above and beyond the call of duty might be said to be SOP as far as you are concerned.

And these are the reasons that at this very you my heartfelt thanks, and my earnest wishes for great happiness for you and yours throughout the days to come.

Most sincerely,
James R. Hendon

• Sensitive Instruments

As a specialist in aircraft instruments, I must point out an obvious error in the reply on your Forum page in the September issue, regarding "sensitive altimeters."

The instrument manuals I am familiar with describe a sensitive altimeter as one that embodys "a highly perfected precision mechanism capable of amplifying diaphragm movement many times." In other words, the sensitivity refers to the ability of the instrument to show small increments of altitude rather than the capability of being reset by hand to a given barometric pressure.

The sensitive altimeter is calibrated in 20-foot increments but it can be read in even greater accuracy. The instrument, of course, has a barometric pressure knob which can be set to the station pressure reduced to sea level.

James J. Hackett
Washington, D. C.

• Radar Run Out

I've always had wonderful cooperation from Air Traffic Service in vectoring me around thunderstorms but on a recent trip from Philadelphia to Buffalo my faith in ATS was severely tried. After a briefing in Philadelphia where I was informed there were scattered thunderstorms on my route I took off secure in the feeling I would be steered around them as usual.

Much to my dismay, New York Center told me their radar had been *upgraded* and could no longer pick up the weather. I soon found myself right square in the middle of a bad thunderstorm, with two badly frightened passengers aboard.

Is it true that the controller can no longer pick up weather or was he too "busy"? If it is true that the weather is electronically filtered out, what provisions are going to be made in the new radar system to give non-radar equipped pilots assistance in flying around thunderstorms?

John A. Williams
Buffalo, N. Y.

Controllers provide advisory service regarding areas of heavy precipitation displayed on their radar scopes when workload permits. The primary responsibility of the controller is to provide separation between IFR aircraft.

During periods of heavy precipitation clutter, aircraft targets cannot be continuously tracked unless radar are operated in the circular polarization mode. This, of course, eliminates much of the weather information.

In the Automated National Airspace System now developing, FAA plans to provide the capability for continuous tracking of aircraft through and around such areas.

• All I want for Christmas . . .

With all the new regulations about flying into high density airports that FAA keeps coming out with, how is a poor low-time Sunday pilot like myself expected to keep up with the regs and stay legal, not to mention hale and hearty?

O. Wright
Dayton, Ohio

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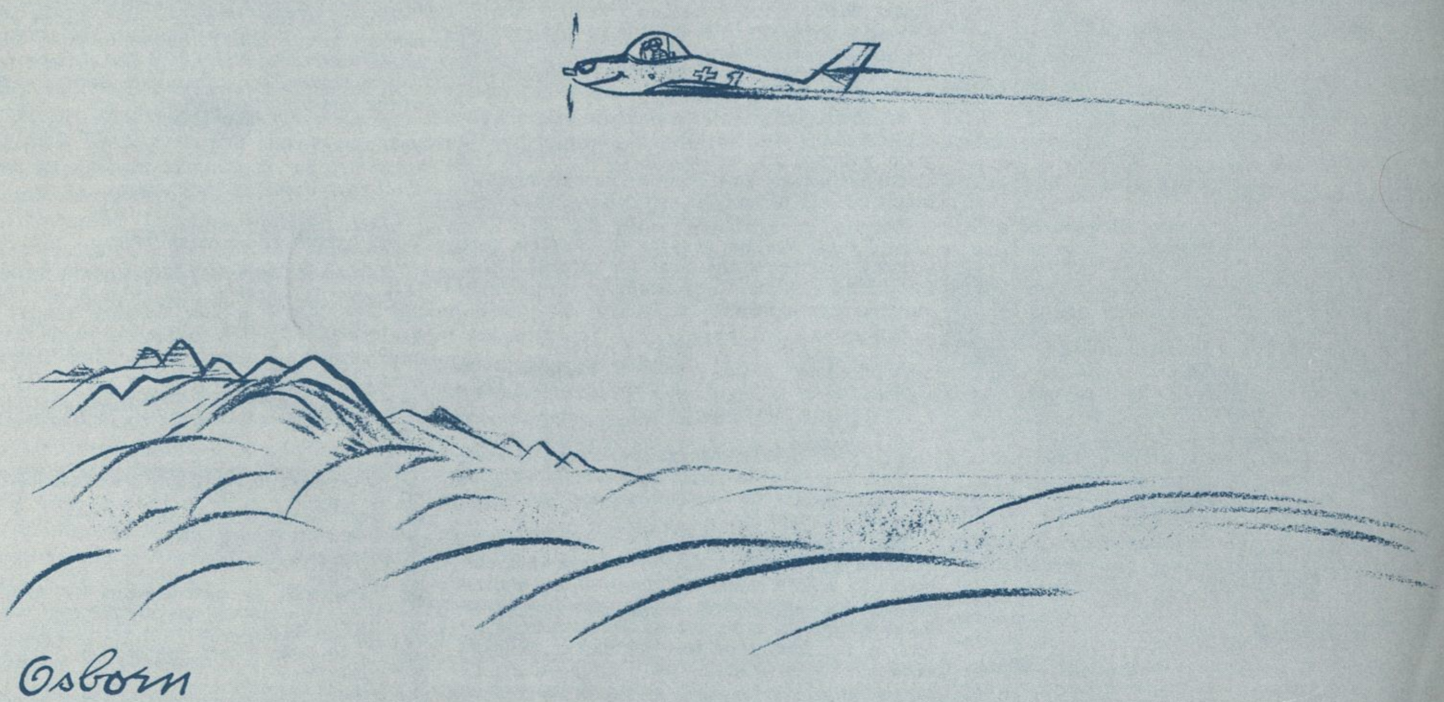

Use oxygen

Suggested by William F. Orner, pilot
Kansas City, Missouri